Title	**Demonstrate and apply advanced knowledge of principles of thermodynamics in mechanical engineering**		
Level	**6**	**Credits**	**15**

Purpose	People credited with this unit standard are able to: describe and analyse mechanical engineering thermodynamic systems; and identify causes of thermodynamic-associated problems and identify remedial actions.

Classification	Mechanical Engineering > Applied Principles of Mechanical Engineering

Available grade	Achieved

Entry information	
Recommended skills and knowledge	Unit 21781, *Explain and apply laws of thermodynamics to mechanical engineering*.

Explanatory notes

1 References
Health and Safety at Work Act 2015 and supporting Regulations.
Resource Management Act 1991.
Hazardous Substances and New Organisms Act 1996.

2 Definitions
Accepted industry practice refers to approved codes of practice and standardised procedures accepted by the wider mechanical engineering industry sectors as examples of best practice.
Workplace procedures refer to procedures used by the organisation carrying out the work and applicable to the tasks being carried out. They may include but are not limited to – standard operating procedures, safety procedures, equipment operating procedures, codes of practice, quality management practices and standards, procedures to comply with legislative and local body requirements.

3 Range
Competence is to be demonstrated in the application of the first and second laws of thermodynamics on four different system types which may include but are not limited to – systems involving the processes of heating, ventilation, air conditioning, refrigeration, combustion, power generation, or compressed air.

4 Assessment information
Numerous reference texts and training manuals on thermodynamics are available and may be used; however, no one textbook or source of information is envisaged. All activities must comply with applicable workplace procedures and must be consistent with accepted industry practice.

Outcomes and evidence requirements

Outcome 1

Describe mechanical engineering thermodynamic systems.

Evidence requirements

1.1 Systems and components are identified using terminology that meets the requirements of system users.

1.2 The principles of operation of thermodynamic systems are explained in terms of key components and ideal cycles.

Range key components may include but are not limited to – boilers, furnaces, process heating, ovens, pumps, compressors, heat exchangers, turbines.

Outcome 2

Analyse mechanical engineering thermodynamic systems.

Evidence requirements

2.1 System components are checked to ensure they match operational requirements for performance and efficiency and are justifiable in terms of thermodynamic principles.

2.2 Combustion of fuels used in thermodynamic systems is established and, where relevant, calorific values are calculated.

2.3 The properties of thermodynamic systems are calculated, and formulae are selected, to meet the requirements of specific mechanical engineering situations.

Range properties may include but are not limited to – pressure, volume, temperature, stored energy, specific heat, density, thermodynamic cycles, mass and volume flow rates;
formulae may include but are not limited to – gas laws, formulae for conservation of energy, formulae for energy flow.

2.4 Instruments for measuring pressure and temperature are selected to match the instruments' performance characteristics and the operational requirements of specific mechanical engineering situations.

Range pressure instruments may include but are not limited to – manometers, Bourdon tubes, barometers;
temperature instruments may include but are not limited to – thermocouples, thermometers, pyrometers, thermistors, temperature sensitive crayons, paints, cones, infrared sensors, resistance thermometers.

Outcome 3

Identify causes of thermodynamic-associated problems and identify remedial actions.

Evidence requirements

3.1 Data is collated and analysis confirms the problem is thermodynamic-associated.

Range data may include but is not limited to – measurements, maintenance records, operational reports, laboratory reports, schematics.

3.2 Likely causes of thermodynamic-associated problems are identified in terms of thermodynamic principles.

3.3 Remedial actions are identified in terms of thermodynamic principles.

Replacement information	This unit standard and unit standard 21781 replaced unit standard 11387.

Planned review date	31 December 2021

Status information and last date for assessment for superseded versions

Process	Version	Date	Last Date for Assessment
Registration	1	27 October 2005	31 December 2016
Rollover and Revision	2	19 March 2010	31 December 2016
Review	3	20 October 2016	31 December 2021

Consent and Moderation Requirements (CMR) reference	0013

This CMR can be accessed at http://www.nzqa.govt.nz/framework/search/index.do.

Please note
Providers must be granted consent to assess against standards (accredited) by NZQA, before they can report credits from assessment against unit standards or deliver courses of study leading to that assessment.

Industry Training Organisations must be granted consent to assess against standards by NZQA before they can register credits from assessment against unit standards.

Providers and Industry Training Organisations, which have been granted consent and which are assessing against unit standards must engage with the moderation system that applies to those standards.

Requirements for consent to assess and an outline of the moderation system that applies to this standard are outlined in the Consent and Moderation Requirements (CMRs). The CMR also includes useful information about special requirements for organisations wishing to develop education and training programmes, such as minimum qualifications for tutors and assessors, and special resource requirements.

Comments on this unit standard

Please contact Competenz qualifications@competenz.org.nz if you wish to suggest changes to the content of this unit standard.